LOWER PASSAIC RIVER RESTORATION PROJECT

LOWER PASSAIC RIVER STUDY AREA RI/FS

SUMMER AND FALL 2012
DISSOLVED OXYGEN MONITORING PROGRAM
ADDENDUM TO THE
QUALITY ASSURANCE PROJECT PLAN

REMEDIAL INVESTIGATION WATER COLUMN MONITORING/PHYSICAL DATA COLLECTION FOR THE LOWER PASSAIC RIVER, NEWARK BAY AND WET WEATHER MONITORING

DRAFT

August 10, 2012
Revision Number: 0
Addendum Number 1

Prepared By:

Wind Ward environmental LLC

200 West Mercer Street, Suite 401
Seattle, Washington 98119

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Acronyms

BERA	baseline ecological risk assessment
CPG	Cooperating Parties Group
CSO	combined sewer overflow
DO	dissolved oxygen
FC	field coordinator
GPS	global positioning system
ID	identification
LPR	Lower Passaic River
LPRSA	Lower Passaic River Study Area
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity unit
PQO	project quality objective
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RM	river mile
SOP	standard operating procedure
TOC	total organic carbon
USACE	US Army Corps of Engineers
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
Windward	Windward Environmental LLC

Introduction

This is an addendum to the *Lower Passaic River Restoration Project Quality Assurance Project Plan: Remedial Investigation Water Column Monitoring/Physical Data Collection for the Lower Passaic River, Newark Bay and Wet Weather Monitoring* (AECOM 2010), hereafter referred to as the Physical Water Quality Monitoring Quality Assurance Project Plan (QAPP). The Physical Water Quality Monitoring QAPP was reviewed by the US Environmental Protection Agency (USEPA) and its Partner Agencies[1] and approved by USEPA in March 2010. This addendum to the Physical Water Quality Monitoring QAPP, hereafter referred to as Physical Water Quality Monitoring QAPP Addendum No. 1, describes the summer and fall 2012 dissolved oxygen (DO) monitoring program that will be conducted to assess DO conditions in the Lower Passaic River Study Area (LPRSA) and at two upstream locations above Dundee Dam during the summer and fall months (i.e., August through December). Data to be collected will include DO concentrations as well as other physical water quality parameters (e.g., temperature, pH, conductivity, and turbidity).

The Physical Water Quality Monitoring Addendum No. 1 includes updates to worksheets relevant to the summer DO monitoring program; it does not include updates to those worksheets or attachments that are not relevant to the monitoring program. Applicable and updated worksheets included in this addendum are presented below:

- Worksheet No. 1 contains the title and approval pages for the addendum.
- Worksheet No. 3 provides the distribution list.
- Worksheet No. 10 describes the specific problem definition for the DO monitoring program.
- Worksheet No. 11 provides the project quality objectives.
- Worksheet No. 13 provides the secondary data criteria and limitations.
- Worksheet No. 14 provides a summary of project tasks.
- Worksheet No. 16 provides the schedule and timeline.
- Worksheet No. 17 provides the sampling design and rationale.
- Worksheet No. 18 provides the proposed monitoring locations and standard operating procedure (SOP) requirements.
- Worksheet No. 21 provides the SOP references.
- Worksheet No. 29 provides a summary of project documents and records.
- Worksheet No. 37 provides the usability assessment.
- Attachment A is an SOP for the DO monitoring program.
- Attachment B is a protocol modification form.

[1] The Partner Agencies include the US Army Corps of Engineers (USACE), New Jersey Department of Environmental Protection (NJDEP), New Jersey Department of Transportation (NJDOT), National Oceanic and Atmospheric Administration (NOAA), and the US Fish and Wildlife Service (USFWS).

QAPP Worksheet No. 1. Title and Approval Page

Addendum to the *Quality Assurance Project Plan, Remedial Investigation Water Column Monitoring/Physical Data Collection for the Lower Passaic River, Newark Bay and Wet Weathering Monitoring*

Document Title

Windward Environmental LLC (Windward)

Lead Investigative Organization

Thai Do, Windward

Preparer's Name and Organizational Affiliation

200 West Mercer St., Suite 401, Seattle, WA 98119, 206.812.5407, thaid@windwardenv.com

Preparer's Address, Telephone Number, and E-mail Address

08/10/12

Preparation Date (mm/dd/yy)

Investigative Organization's Project Manager:

Signature

Lisa Saban, Windward, Date

Printed Name/Organization/Date

Investigative Organization's Task QA/QC Manager:

Signature

Tad Deshler, Windward, Date

Printed Name/Organization/Date

Project Coordinators:

Signature

Bill Potter, de maximis, inc., Date

Printed Name/Organization/Date

Signature

Robert Law, de maximis, inc., Date

QAPP Worksheet No. 1. Title and Approval Page

	Printed Name/Organization/Date
Approval Signatures:	
USEPA Project Manager	
Approval Authority	Signature
	Stephanie Vaughn, USEPA, Date
	Printed Name/Title/Date
USEPA Project QA Officer	
Approval Authority	Signature
	William Sy, USEPA, Date
	Printed Name/Title/Date

QAPP Worksheet No. 3. Distribution List

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
Lisa Saban	Investigative Organization Project Manager	Windward	206.812.5429	lisas@windwardenv.com
Mike Johns	Technical Advisory Team Member	Windward	206.812.5418	mikej@windwardenv.com
Tad Deshler	Investigative Organization Task QA/QC Manager	Windward	206.812.5406	tad@windwardenv.com
Kimberley Goffman	Investigative Organization Information Manager	Windward	206.812.5414	kimg@windwardenv.com
Thai Do	Field Coordinator/Site Safety and Health Officer	Windward	206.812.5407	thaid@windwardenv.com
Bill Potter/Robert Law	Project Coordinators	de maximis, inc.	908.735.9315	otto@demaximis.com rlaw@demaximis.com
William Hyatt	Coordinating Counsel	K&L Gates	973.848.4045	william.hyatt@klgates.com
Ken Cadmus	Manager, Coastal Sciences (Vessel/Mooring Subcontractor Lead)	Ocean Surveys, Inc.	860.388.4631 ext. 126	kac@oceansurveys.com
Stephanie Vaughn	USEPA Project Manager	USEPA Region 2	212.637.3914	vaughn.stephanie@epamail.epa.gov
Chuck Nace	USEPA Risk Assessor	USEPA Region 2	212.637.4164	nace.charles@epa.gov
Lisa Baron	Project Manager	USACE	917.790.8306	Lisa.A.Baron@usace.army.mil
Janine MacGregor	Project Coordinator	NJDEP	609.633.0784	Janine.MacGregor@dep.state.nj.us
Timothy Kubiak	Assistant Supervisor of Environmental Contaminants	USFWS	609.646.9310, ext. 26	tim_kubiak@fws.gov
Reyhan Mehran	Coastal Resource Coordinator	NOAA	212.637.3257	reyhan.mehran@noaa.gov

QAPP Worksheet No. 10. Problem Definition

QAPP Worksheet No. 10. Problem Definition

The problem to be addressed by the project:
Previous *in situ* water quality data were collected during the physical water column monitoring events conducted in fall 2009 and spring 2010 to characterize the aquatic system and movement of suspended sediment in the LPRSA. Monitoring was not conducted during the summer (during times of low freshwater input), and DO concentrations were not measured (AECOM 2010). Measuring DO during the summer and fall seasons would fill these data gaps. This information will also be used, along with other site-specific qualitative data from previous studies, to provide information on the environmental setting for the baseline ecological risk assessment (BERA) to help fully characterize the ecological system present within the LPRSA (Windward and AECOM [in prep]).
The environmental questions being asked:
The specific question defined for the summer and fall 2012 DO monitoring program addressed in this addendum is: "What are the summer and fall season levels and ranges of DO and other physical water quality parameters (i.e., temperature, pH, conductivity, and turbidity) at near-bottom areas of the LPRSA? Do the levels of near-bottom DO become depressed during summer periods? If the DO levels become depressed in the summer, when do the DO levels rebound?"
The rationale for sample locations:
Multi-parameter water quality meters will be deployed at 11 identified monitoring locations in the LPRSA and 2 upstream background locations above Dundee Dam to measure DO concentrations and other parameters during the summer season when the LPRSA is most likely to have depressed DO concentrations in near-bottom water. During this time of year, freshwater input is expected to be relatively low (USGS 2012), water temperatures are expected to be relatively high (USGS 2012), and biological oxygen demand from sediment may be elevated, all of which affect the concentration of DO in the water column. The multi-parameter water quality meters will be removed from the LPRSA in the late fall season when freshwater input is expected to be relatively high (USGS 2012), water temperatures are expected to be relatively low (USGS 2012), and the DO in the water column may be high. Monitoring locations were selected to be representative of the communities influenced by the salinity regimes in the river. The 11 LPRSA monitoring locations and two upstream monitoring locations are distributed as follows: • Three monitoring locations in the estuarine zone near the mouth of the Lower Passaic River (LPR) • Two monitoring locations in the transitional zone between River Mile (RM) 4.0 and RM 6.0 • Six freshwater monitoring locations (three in the upper and three in the lower freshwater segment)

QAPP Worksheet No. 10. Problem Definition

Two upstream background freshwater monitoring locations above Dundee Dam
Project decision conditions:
The conditions for project decisions (i.e., those decisions that may require communication between the Cooperating Parties Group (CPG) and USEPA for the monitoring event) include the need to relocate sampling locations, adjust sampling methods, and/or delay, suspend, or discontinue monitoring. If a monitoring location cannot be occupied, a new location will be selected upon agreement between USEPA and CPG. The CPG will immediately suspend operations under conditions of extreme weather and/or environmental conditions that are a threat to worker health and safety.

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements

What will the data be used for?
The data collected during the summer and fall 2012 DO monitoring program described in this Physical Water Quality Monitoring QAPP addendum will be used to help characterize the aquatic system of the LPRSA. This information will be used, along with other site-specific qualitative data from previous studies, to provide information on the environmental setting for the BERA to help fully characterize the ecological system present within the LPRSA (Windward and AECOM [in prep]).
What types of data are needed?
In situ water quality data collected will include near-bottom (i.e., 8 in. above bottom) DO concentrations, temperature, pH, conductivity, and turbidity at 11 locations in the LPRSA and 2 upstream background locations between Dundee Dam and the I-80 bridge. Previous *in situ* water quality data were collected during the physical water column monitoring events conducted in fall 2009 and spring 2010. However, no monitoring was conducted during the summer (during times of low freshwater input), and DO concentrations were not measured (AECOM 2010).
Matrix
The matrix to be sampled will be near-bottom surface water. Measurements of DO and other physical water quality parameters (e.g., temperature, pH, conductivity, and turbidity) will be compiled for the summer and fall 2012 monitoring program.
How "good" do the data need to be in order to support the environmental decision?
Near-bottom DO concentrations and measurements of other physical water quality parameters (i.e., temperature, pH, conductivity, and turbidity) will be collected *in situ* from l11 locations throughout the LPRSA and 2 upstream background locations above Dundee Dam (Figure 1). The multi-parameter water quality meters will be removed from the LPRSA in the late fall season when freshwater input is expected to be relatively high (USGS 2012), water temperatures are expected to be relatively low (USGS 2012), and the DO in the water column may be high. If this assumption proves to be untrue, then the monitoring program may be extended and/or re-started the following late winter/early spring. The monitoring locations have been spatially distributed throughout the LPRSA and are representative of the salinity regimes (i.e., estuarine zone, transition zone, and freshwater zone. TOC was one of the factors evaluated during the selection of monitoring locations, and the TOC concentrations for LPRSA and Dundee Lake sediment samples are shown by percentile range in Figure 1. Samples were placed in areas with a range of TOC concentrations. The optical, self-wiping DO sensor will have an operating range of 0 to 50 mg/L, with a resolution of 0.01 mg/L. The accuracy of the DO measurements will be ± 0.1 mg/L or 1% of the reading, whichever is greater, when DO is in the range of 0 to 20 mg/L and 15% of

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements

the reading when DO is in the range of 20 to 50 mg/L.

The temperature sensor will have an operating range of -5 to +50 °C, with a resolution of 0.01 °C and accuracy of ± 0.15 °C. The pH sensor will have an operating range of 1 to 14 pH units, with a resolution of 0.01 pH unit and an accuracy of ± 0.2 pH unit. The conductivity sensor will have a range of 0 to 100 mS/cm, with a resolution of 0.001 to 0.1 mS/cm (range dependent) and an accuracy of ± 0.5% of the reading + 0.001 mS/cm. The turbidity sensor will have an operating range of 0 to 1,000 nephelometric turbidity units (NTUs), with a resolution of 0.1 NTU and an accuracy of 2% of the reading or 0.3 NTU, whichever is greater.

New Jersey surface water quality standards and other benchmarks for the protection of aquatic life in surface water will be used to determine if the DO is adequate. As an example, the New Jersey surface water DO criteria are 5.0 mg/L (24-hour average) but not less than 4.0 mg/L for surface water in the LPR from the outlet of Osborn Pond (upstream of Dundee Dam) to the confluence with the Second River and not less than 3.0 mg/L for the surface water in the LPR from the confluence with the Second River to the mouth of the LPR (New Jersey Administrative Code 7:9B). These benchmarks are included but not intended to be a direct causal link between conditions now and those that existed in 2009/2010.

How many data are needed?

Measurements of near-bottom DO concentrations, among other water quality parameters, will be collected *in situ* from 11 locations in the LPRSA and 2 upstream background locations above Dundee Dam. The rationale for the selection of the 13 locations is provided in Worksheet No. 18 of this addendum.

Multi-parameter water quality meters will be deployed in early August during the summer season when the LPRSA will be most susceptible to depressed DO concentrations in near-bottom water and maintained through December (the fall season). During the summer, the freshwater input is expected to be relatively low (USGS 2012), water temperatures are expected to be relatively high (USGS 2012), and the biological oxygen demand of sediment may be elevated, all of which affect the concentration of DO in the water column. During the fall season, the DO maybe relatively high because freshwater inputs may increase and water temperatures may decrease (USGS 2012). The levels of these parameters can vary from hour to hour and day to day, and these short-term variations have the potential to influence biotic populations. It will therefore be necessary to continuously monitor and collect data at 15-minute intervals over the duration of the program.

Where, when, and how should the data be collected/generated?

The selected monitoring locations (and the rationale for each location) for the DO monitoring program are presented in Worksheet No. 18 of this addendum and shown in Figure 1. Methods used to collect DO concentration data will follow the SOPs detailed in Attachment A: SOP—Dissolved Oxygen Monitoring Program.

At each location, a YSI (or similar) multi-parameter water quality meter will be attached to a mooring station in a bottom mount and

QAPP Worksheet No. 11. Project Quality Objectives/Systematic Planning Process Statements

deployed for 120 days. In addition to DO, temperature, pH, conductivity, and turbidity data will be collected at 15-minute intervals. Because the meter's battery life is not expected to exceed 30 days, and DO is the first parameter to drift with lower power, the monitoring locations will be serviced, and data collected and stored in each meter will be downloaded approximately every 20 days (e.g., at Day 20, Day 40, Day 60, Day 80, Day 100, and upon completion at Day 120). During each periodic monitoring task, a separate meter will be used to obtain a vertical profile at each station to measure DO, temperature, pH, conductivity, and turbidity prior to retrieving and after redeployment of the original meter. Instruments will be calibrated prior to redeployment.
Who will collect and generate the data?
Windward personnel will provide the field monitoring coordination, and Ocean Surveys, Inc., will provide the monitoring equipment and field personnel necessary to set up, deploy, and retrieve the monitoring equipment and perform periodic monitoring tasks (e.g., maintain and calibrate equipment, download data) every 20 days until completion.
How will the data be reported?
Updates will be communicated (e.g., via telephone conversation, e-mail) to CPG project managers and project coordinators. An electronic database that includes the coordinates for the monitoring locations, the times of monitoring, monitoring depths, and the water quality measurements (e.g., DO, temperature, pH, conductivity, and turbidity) for each location will be maintained. A data summary report that presents the DO concentrations and other collected water quality measurements will be provided within 90 working days after the completion of the monitoring program. The data summary report will document any modifications to the proposed monitoring program outlined in this Physical Water Quality Monitoring QAPP addendum.
How will the data be archived?
Data records, forms, and notes will be scanned and stored electronically in a project file. Hard copies will be archived at Windward's main office in Seattle, Washington. Similarly, once the data report has been issued, it will be archived electronically and as hard copy.

QAPP Worksheet No. 13. Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/collection dates)	How Data Will Be Used	Limitations on Data Use
DO concentration measurements	The New Jersey Harbor Dischargers Group. *The New Jersey Harbor Dischargers Group 2008 Water Quality Report* (NJHDG 2008).	New Jersey Harbor Dischargers Group. DO data, 2004 to 2008.	Data were used to help refine proposed monitoring locations in LPRSA.	DO measurements were limited to either once weekly (May through September) or twice monthly (October through April). Measurements from Passaic River stations were collected at mid-depth (e.g., not near bottom). Because DO measurements were taken only once daily during daylight hours (when DO levels were expected to be highest) it is not possible to compare results with standards involving 24-hour averages. The quality of DO measurements is unknown.

QAPP Worksheet No. 14. Summary of Project Tasks

Project Area: LPRSA	
Sampling Tasks:	The 120-day DO monitoring program will be conducted in the LPRSA and above Dundee Dam from August 2012 through December 2012 (proposed schedule is presented in Worksheet No. 16). Ten monitoring locations (Worksheet No. 18 and Figure 1) will be visited approximately every 20 days from the initial day of deployment until day 120. One field team consisting of two field personnel will conduct the monitoring program. During the 120-day program, the ten monitoring locations will visited every 20 days after initial deployment to retrieve and download data and service (e.g., calibrate, defoul) and redeploy the multi-parameter water quality meters. SOPs applicable to the field monitoring program are presented in the attached SOP (Attachment A: SOP—Dissolved Oxygen Monitoring Program) and in Attachments B, C, H, and L of the *Lower Passaic River Restoration Project Quality Assurance Project Plan: Surface Sediment Chemical Analyses and Benthic Invertebrate Toxicity and Bioaccumulation Testing* (Windward 2009), hereafter to as the Benthic QAPP.
Analysis Tasks:	At each monitoring location, information (e.g., coordinates and any relevant site condition observations) will be recorded in the field logbook.
QC Tasks:	All field notes and forms completed during the monitoring program will be checked daily by the field coordinator (FC). The FC will also communicate daily with the monitoring program quality assurance (QA)/quality control (QC) manager to confirm that project quality objectives (PQOs) are being met. Electronic equipment (e.g., multi-parameter water quality meters, global positioning system [GPS] units) will be calibrated, maintained, tested, and inspected according to manufacturers' specifications, as necessary, to ensure that they are functioning properly (refer to Worksheet No. 22 of the Benthic QAPP (Windward 2009)). During each periodic monitoring task, a separate meter will be used to obtain a vertical profile at each station to measure DO, temperature, pH, conductivity, and turbidity prior to retrieving and after redeployment of the original meter. Instruments will be calibrated prior to redeployment.
Secondary Data:	The primary objective of this monitoring program is to collect *in situ* DO concentrations in order to calculate 24-hour averages. Secondary *in situ* water quality parameters (e.g., temperature, pH, conductivity, and turbidity) will also be collected, reviewed, and used to calculate 24-hour averages.
Data Management Tasks:	The data management task will include keeping accurate records of field activities and observations so that project team members using the data will have accurate and appropriate documentation. Data management activities will be conducted in accordance with the project data management plan based on Technical Committee data rules. Field data will be stored in its native format and in the project database. GPS data will also be downloaded and stored electronically in a project file. Subsequently, the spatial data will be mapped for the data report.

QAPP Worksheet No. 14. Summary of Project Tasks

Documentation and Records:	It is important that field activities be documented in an organized and chronologically accurate manner. All field activities will be recorded in a field logbook maintained by the FC. The field logbook is intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the sampling period. Procedures for documentation are presented in Attachment H of the Benthic QAPP (Windward 2009). All relevant forms and records are presented on Worksheet No. 29 of this addendum and the Benthic QAPP. In general, the following information must be recorded: • The identities and affiliation of the personnel conducting field activities • Model numbers and serial numbers of instruments and/or equipment being used, to the extent available • A description of the type of field work being conducted and the equipment used • The dates and times that the field activities were initiated and completed, with specific information for each task (e.g., recording of the time that activities commenced at each individual location, if applicable) • Specific locations where monitoring activities were conducted. • The general methodology used to conduct the monitoring activities • Communications with project managers and personnel regarding monitoring activities • Field-collected monitoring data • Daily health and safety briefings • Deviations from this Physical Water Quality Monitoring QAPP addendum, the reason for change; and any corrective actions taken. Corrective actions will be electronically documented on the Protocol Modification Form (Attachment B)). • Documentation of any photos associated with monitoring locations or field monitoring activities in the field logbook, including the date, time, photographer, and brief description All entries must be made in language that is objective, factual, and free of personal feelings or other terminology that might prove inappropriate. A record of all personnel briefed on the health and safety plan will be maintained by the FC, site safety and health officer, or designee. The record will be archived at Windward's Seattle office upon completion of the monitoring program.
Assessment/Audit Tasks:	The FC will also communicate frequently with the task QA/QC manager to confirm that PQOs are being met. Assessment/audit tasks will be conducted, as summarized in Worksheet No. 31 of the Benthic QAPP (Windward 2009). Reviews of field activities/monitoring method compliance will be conducted periodically.

QAPP Worksheet No. 14. Summary of Project Tasks

Data Review Tasks:	All data records will be reviewed by the FC for completeness and accuracy and verified by the task QA/QC manager or a designee.
Deliverables:	Following completion of the monitoring program, the *in situ* data will be presented in a data summary report. A map that illustrates the actual monitoring locations will also be prepared. The data summary report will be provided to USEPA within 90 days after completion of the DO monitoring program.

QAPP Worksheet No. 16. Project Schedule/Timeline Table

Activities	Organization	Date (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date of Initiation	Anticipated Date of Completion		
Prepare Physical Water Quality Monitoring QAPP Addendum No. 1 (DO monitoring program addendum) and submit to USEPA	Windward	06/04/12	07/27/12	Physical Water Quality Monitoring QAPP Addendum No. 1	07/27/12
Conduct DO monitoring program	Windward/Ocean Surveys, Inc.	08/07/12	12/06/12	See below	See below
Prepare and deliver DO monitoring program data summary report to USEPA	Windward	Upon completion of monitoring program	90 days after the monitoring program is complete	DO monitoring program data report	90 days after the monitoring program is complete

QAPP Worksheet No. 17. Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

The sampling approach for monitoring DO in the LPRSA has been designed to obtain continuous DO data in the 17.4-mile stretch of the LPRSA and select background locations above Dundee Dam and to assess DO variability in the LPRSA. Both physical and biological processes may have an influence on DO. Temperature and salinity are among the physical factors that influence DO. Temperature is inversely related to the solubility of oxygen in water (i.e., as temperature increases, oxygen is less soluble and DO measurements are lower). Conversely, salinity reduces the solubility of oxygen in water. Biological oxygen demand (i.e., the amount of oxygen used by micro-organisms during aerobic decomposition of organic matter) is another factor that affects DO and may be influenced by sediment TOC concentrations.

Locations in the LPRSA (Figure 1) have been selected to measure near-bottom (i.e., 8 in. above bottom) DO concentrations and other parameters (i.e., temperature, pH, conductivity, and turbidity) during the summer season when the LPRSA would be most susceptible to depressed DO concentrations in near-bottom water. During this time of year, freshwater input is expected to be relatively low (USGS 2012), water temperatures are expected to be relatively high (USGS 2012), and biological oxygen demand from sediment may be elevated, all of which would affect the concentration of DO in the water column. Monitoring locations have been selected to be representative of the salinity regimes in the LPRSA (i.e., estuarine zone, transition zone, and freshwater zone) and in areas with a range of TOC in the sediment (Figure 1). In addition, two monitoring locations were placed upstream, above Dundee Dam to establish background DO concentrations.

This information will also be used, along with other site-specific qualitative data from previous studies, to provide information on the environmental setting for the BERA to help fully characterize the ecological system present within the LPRSA (Windward and AECOM [in prep]).`A description of the sampling approach is provided in Worksheet No. 11 (see the section entitled “Where, when, and how should the data be collected/generated?”). In summary, 11 locations within the LPRSA (i.e., 3 estuarine, 2 transition zone, and 6 freshwater [3 in an upper and 3 in a lower segment]) locations as well as 2 background locations upstream of Dundee Dam will be monitored for DO.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations):

Figure 1 provides the sampling locations where DO and other water quality parameters will be measured in water. The rationale for each location is presented in Worksheet No. 18. Eleven locations within the LPRSA (i.e., three estuarine, two transition zone, and six freshwater locations [three in an upper and three in a lower segment]), as well as two background locations upstream of Dundee Dam, will be monitored for DO. Attachment A describes the equipment SOPs to be used to measure DO and other water quality parameters, including quality control procedures.

At each location, a YSI multi-parameter water quality meter will be attached to a mooring station in a bottom mount and deployed for 120 days. In addition to DO, temperature, pH, conductivity, and turbidity data will be collected continuously at 15-minute intervals. Because the meter’s battery life is not expected to exceed 30 days, and DO is the first parameter to drift with lower power, data collected and stored in each meter will be downloaded every 20 days (e.g., at Day 20, Day 40, Day 60, Day 80, Day 100, and upon completion at Day 120). Windward personnel will be present during the initial setup and deployment (Day 0). Ocean Surveys, Inc., personnel will conduct the interim monitoring and equipment maintenance at Day 20, Day 40, Day 60, Day 80, Day 100, and Day 120, as well as perform demobilization without assistance from Windward

QAPP Worksheet No. 17. Sampling Design and Rationale

personnel.

QAPP Worksheet No. 18. Proposed Sampling Locations and Methods/SOP Requirements Table

Monitoring Location/ID Number	Easting (X)[a]	Northing (Y)[a]	River Mile	Data Collection Method[b]	Rationale for Monitoring Location
LPRW01	596945	687185	0.7	Multi-parameter water quality meter	Mid-channel; estuarine location near mouth of river near elevated sediment TOC concentrations; not near a CSO.
LPRW02	597906	694720	2.1	Multi-parameter water quality meter	Mid-channel; estuarine location with low sediment TOC concentrations; not near a CSO; requested by USEPA
LPRW03	596993	695187	2.3	Multi-parameter water quality meter	West/south side of channel; estuarine location near mid-range sediment TOC concentrations; not near a CSO.
LPRW04	588674	692312	4.2	Multi-parameter water quality meter	West/south side of channel; transition between estuarine and fresh water with elevated sediment TOC concentrations; downstream of CSO.
LPRW05	584714	696899	5.5	Multi-parameter water quality meter	Mid-channel; transition between estuarine and fresh water with mid-range and variable sediment TOC concentrations (sediment in vicinity have TOC concentrations that range from < 25th percentile to > 75th percentile); near known CSO.
LPRW06	590735	713144	8.8	Multi-parameter water quality meter	East side of channel; freshwater location in the lower segment with low sediment TOC concentrations; not near a CSO; requested by USEPA.
LPRW07	590985	713657	9.0	Multi-parameter water quality meter	Mid-channel; freshwater location in the lower segment with elevated sediment TOC concentrations; not near a CSO.
LPRW08	592280	716789	9.6	Multi-parameter water quality meter	Mid-channel; freshwater location in the lower segment with mid-range and variable sediment TOC concentrations (sediment in vicinity has TOC concentrations that range from > 25th percentile to > 90th percentile); not near a CSO.
LPRW09	596045	730907	12.8	Multi-parameter water quality meter	West side of channel; freshwater location in the upper segment with mid-range and variable TOC concentrations (sediment in vicinity have TOC concentrations that range from < 25th percentile to > 90th percentile); not near a CSO.
LPRW10	597357	737245	14.1	Multi-parameter water quality meter	Mid-channel; freshwater location in the upper segment with elevated sediment TOC concentrations; near known CSO.
LPRW11	599317	737143	14.7	Multi-parameter water quality meter	Mid-channel; freshwater location in the upper segment with low sediment TOC concentrations; not near a CSO; requested by USEPA.
UPRW01	594499	748359	17.7	Multi-parameter water quality meter	Mid-channel background sampling location. Upstream location is above Dundee Dam and below the I-80 bridge; downstream of CSO outfall (RM 18.85).

QAPP Worksheet No. 18. Proposed Sampling Locations and Methods/SOP Requirements Table

UPRW02	594373	751119	18.3	Multi-parameter water quality meter	Mid-channel; background sampling location. Upstream location is above Dundee Dam and below the I-80 bridge; downstream of CSO outfall (RM 18.85).

[a] New Jersey State Plane (US survey ft).
[b] Refer to Attachment AA: SOP-Dissolved Oxygen Monitoring Program

CSO – combined sewer overflow
ID – identification
RM – river mile
SOP – standard operating procedure
TOC – total organic carbon

QAPP Worksheet No. 21. Project Sampling SOP References Table

SOP Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
LPR-FI-04[a]	SOP – Dissolved Oxygen Monitoring Program	Windward	Multi-parameter water quality meter	N	Attachment AA

[a] Next sequential number in the Physical Water Quality Monitoring QAPP.

LPR – Lower Passaic River
QAPP – quality assurance project plan
SOP – standard operating procedure

QAPP Worksheet No. 29. Project Documents and Records Table

Monitoring Program Documents and Records
Onsite Analysis Documents and Records
Downloaded electronic water quality data files
Deliverables
DO monitoring program data summary report

QAPP Worksheet No. 37. Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
All observations made during the DO monitoring program will be considered usable if they are made according to the methods described in the applicable SOPs (Attachment A: SOP—Dissolved Oxygen Monitoring Program) and are reasonable (results will be evaluated based on expected levels and potential for equipment malfunction, fouling, and calibration issues). No formal data usability assessment report will be prepared for the DO monitoring program. Any deviations from the SOPs will be documented, as appropriate, in the field logbook and on the Protocol Modification Form (Attachment B) and also approved by USEPA or its authorized representative.

References

AECOM. 2010. Lower Passaic River Restoration Project. Quality assurance project plan/field sampling plan addendum, remedial investigation water column monitoring/physical data collection for the Lower Passaic River, Newark Bay and wet weather monitoring. Prepared for Lower Passaic River Cooperating Parties Group. AECOM, Newark, NJ.

Malcolm Pirnie. 2006. Lower Passaic River Restoration Project. Draft geochemical evaluation (step 2). Prepared for US Environmental Protection Agency Region 2 and US Army Corps of Engineers. Malcolm Pirnie, Inc., White Plains, NY.

NJHDG. 2008. 2008 water quality report. The New Jersey Harbor Dischargers Group, Passaic Valley Sewerage Commissioners, Newark, NJ.

USGS. 2012. USGS 01390000 Passaic River at Garfield NJ: streamflow and temperature. National Water Information System Web Interface [online]. US Geological Survey, West Trenton, NJ. [Cited 8/2/12.] Available from: http://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=01390000.

Windward. 2009. Lower Passaic River Restoration Project. Lower Passaic River Study Area RI/FS. Quality Assurance Project Plan: Surface sediment chemical analyses and benthic invertebrate toxicity and bioaccumulation testing. Final. Prepared for Cooperating Parties Group, Newark, New Jersey. Windward Environmental LLC, Seattle, WA.

Windward, AECOM. [in prep]. Lower Passaic River Restoration Project. Revised risk analysis and risk characterization plan for the Lower Passaic River Study Area. Draft. Prepared for Cooperating Parties Group, Newark, New Jersey. Windward Environmental LLC, Seattle, WA; AECOM, Inc., Westford, MA.

Attachment A: SOP—Dissolved Oxygen Monitoring Program

I. Introduction

This standard operating procedure (SOP) describes the equipment, field procedures, and documentation necessary for the collection of physical water property data associated with the Lower Passaic River Study Area (LPRSA) using dissolved oxygen (DO), pH, conductivity, temperature, and turbidity sensors from a boat or other sampling platform during monitoring/data collection activities. This SOP also provides for the moored deployment of instrument sensors. Other SOPs may be used with this SOP and are addressed in the *Lower Passaic River Restoration Project Quality Assurance Project Plan: Surface Sediment Chemical Analyses and Benthic Invertebrate Toxicity and Bioaccumulation Testing* (Windward 2009), hereafter referred to as the Benthic Quality Assurance Project Plan (QAPP). All data, monitoring location coordinates, and times will be included in an electronic database, which will be provided to the US Environmental Protection Agency (USEPA).

It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the project quality assurance (QA) manager and the remedial investigation (RI) task manager and communicated to the Cooperating Parties Group (CPG) project coordinator and the USEPA remedial project manager. Deviations from this SOP will be documented on the Protocol Modification Form (Attachment B). The procedure employed will be documented in the report that summarizes the results of the monitoring program.

II. Preparations for the Monitoring Program

Physical Water Quality Monitoring QAPP Addendum No. 1 identifies monitoring locations and frequencies. Field personnel are responsible for reviewing the Benthic QAPP (Windward 2009) and Physical Water Quality Monitoring QAPP Addendum No. 1 prior to conducting field monitoring activities and ensuring that all field equipment are available and in acceptable condition.

III. Equipment and Supplies

The following equipment list identifies materials that may be needed to carry out the physical water quality monitoring procedures identified in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, depending on field conditions.

- Physical Water Quality Monitoring QAPP Addendum No. 1
- Camera
- Field logbook and field form
- Multi-parameter water quality meters with DO, pH, conductivity, temperature, and turbidity sensors (YSI 6920 or equivalent)
- Connective (serial) cabling
- Weight-bearing line/cable and anchor weight

- Field laptop computer
- Chemical-free wipes
- Tap water supply
- Manufacturer's operating manual
- Replacement batteries
- Vessel fitted with differential global positioning system (DGPS) navigational equipment
- Personal protective equipment (i.e., personal flotation devices, nitrile gloves)

The following are required for moored operations:

- Buoy, instrument caging, and connector deployment cable/chain
- Battery and memory capacity sufficient for the deployment period

IV. Location of Monitoring Locations

The position of the monitoring locations will be established based on the target locations identified in this QAPP addendum. The probe will be placed near the river bottom (i.e., 8 in. above the bottom). The positioning procedures are described in Attachments B and C: Locating Sample Points Using a Hand-Held Global Positioning System (GPS) and Locating Sample Points Using a Boat-Mounted Global Positioning System (GPS), respectively, to the Benthic QAPP (Windward 2009). Proposed monitoring locations are presented on Figure 1 of Physical Water Quality Monitoring QAPP Addendum No. 1 and summarized on Worksheet No. 18 of Physical Water Quality Monitoring QAPP Addendum No. 1. Monitoring locations may be moved in the field, based on *in situ* conditions and observations, which may include moving to a more optimal location.

V. Procedures

A. Calibration

All of the sensors, except that for temperature, require periodic calibration to ensure high performance. The transport/calibration cup that comes with the probe module serves as a calibration chamber for all calibrations and minimizes the volume of calibration reagents required. Alternatively, laboratory glassware may be used to perform calibrations. The key to successful calibration is to ensure that the sensors are completely submersed when calibration values are entered. Recommended volumes should be used when performing calibrations. It is further recommended that a bucket with ambient-temperature water be used to rinse the probe module between calibration solutions.

The following are recommended prior to calibration:

- Ensure that port plugs are installed in all ports in which sensors are not installed. It is extremely important that these electrical connectors be kept dry.
- Loosen the seal to allow pressure equilibration before calibration. The DO calibration is a water-saturated air calibration.
- Ensure that an o-ring is installed in the o-ring groove of the transport/calibration cup bottom cap and that the bottom cap is securely tightened. Do not over-tighten inasmuch as this could cause damage to

the threaded portions.

- Remove the probe sensor guard, if it is installed.
- Remove the o-ring from the probe module, if installed, and inspect the o-ring for obvious defects and, if necessary, replace it with the supplied spare o-ring.
- When using the transport/calibration cup for the DO percent saturation calibration, ensure that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly and that approximately 1/8 inch of water is present in the cup.

Some calibrations can be performed with the probe module upright or upside down. A separate clamp and stand, such as a ring stand, is required to support the probe module in the inverted position. The approximate volumes of the reagents are specified below for both the upright and upside-down orientations.

Table 1. Calibration Volumes

Sensor to be Calibrated	Volume of Reagent by Orientation	
	Upright	Upside Down
Conductivity	55 mL	55 mL
pH	30 mL	60 mL

Source: YSI Environmental (YSI 2011)

Calibration will be performed for DO, conductivity, turbidity, and pH.

B. DO Calibration

To calibrate for DO:

1 Turn on the meter and select “calibrate” from the main menu. Select “dissolved oxygen” from the calibrate screen. Select “DO %” from the DO calibration screen. Note that calibrating any one DO option (% or mg/L) automatically calibrates the other.

2. Place approximately 3 mm (1/8 inch) of water in the bottom of the transport/calibration cup.
3. Place the probe module into the transport/calibration cup, making sure that the DO and temperature sensors are not immersed in the water.
4. Engage only one or two threads of the transport/calibration cup to ensure that the DO sensor is vented to the atmosphere.
5. Use the keypad to enter the current local barometric pressure. If the unit has the optional barometer, no entry is required. Barometer readings that appear in meteorological reports are generally corrected to sea level and must be uncorrected before use (refer to the YSI operations manual (YSI 2011) for additional information, as necessary).
6. Press “Enter.” The DO percent saturation calibration screen will be displayed. Allow approximately 10 minutes for the air in the

transport/calibration cup to become water saturated and for the temperature to equilibrate before proceeding. The current readings of all enabled sensors will appear on the screen and change with time as they stabilize.

7. Observe the reading under "DO %." When the reading shows no significant change for approximately 30 seconds, press "Enter." The screen will indicate that the calibration has been accepted and display a prompt to press "Enter" again to continue.
8. Press "Enter." This will bring up the DO calibration screen. Press "Escape" to return to the calibrate menu.
9. Rinse the probe module and sensors in tap or purified water and dry.

C. Conductivity Calibration

To calibrate for conductivity:

1. Turn on the meter and select "calibrate" from the main menu. Select "conductivity" from the calibrate screen. Select "specific conductance" from the conductivity calibration screen. Note that by calibrating specific conductance, conductivity will automatically be updated.
2. Place the correct amount of conductivity calibration reagent (see Table 1) into a clean, dry, and pre-rinsed transport/calibration cup. For maximum accuracy, the conductivity calibration reagent should be within the same conductivity range as the samples that will be measured. For fresh water, use a 1-mS/cm conductivity standard. For brackish water, use a 10-mS/cm conductivity standard. For seawater, use a 50-mS/cm conductivity standard.

   WARNING: Calibration reagents may be hazardous to your health.
3. Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of the calibration reagent that can be discarded. Be careful to avoid the cross-contamination of calibration reagents. Make certain that there are no salt deposits around the oxygen and pH/oxidation reduction potential sensors, particularly if low-conductivity calibration reagents are being employed.
4. Carefully immerse the sensor end of the probe module into the calibration reagent.
5. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell. The sensor must be completely immersed past its vent hole. Using the recommended volumes from Table 1, ensure that the vent hole is covered.
6. Screw the transport/calibration cup on the threaded end of the probe module and tighten securely. Do not over-tighten inasmuch as this could cause damage to the threaded portions.
7. Use the keypad to enter the calibration value of the calibration reagent being used. Be sure to enter the value in mS/cm at 25°C.

8. Press "Enter." The conductivity calibration screen will be displayed. Allow at least 1 minute for temperature equilibration before proceeding. The current readings of all enabled sensors will appear on the screen and change with time as they stabilize.
9. Observe the reading under specific conductance. When the reading shows no significant change for approximately 30 seconds, press "Enter." The screen will indicate that the calibration has been accepted and display a prompt to press "Enter" again to continue.
10. Press "Enter." This will bring up the conductivity calibrate selection screen. Press "Escape" to return to the calibration menu.
11. Rinse the probe module and sensors in tap or purified water and dry.

D. Turbidity Calibration

To calibrate for turbidity:

1. The first step is to confirm that the turbidity probe is functioning properly. Confirm that the wiper parks correctly. It should be positioned at approximately 180° opposite the optics. The wiper must reverse direction during the wipe cycle. The output of the probe must increase when you place your finger in front of the optics. If the wiper does not park correctly or reverse direction, then make sure that the underside of the wiper is clean and free of mud, sediment, or other fouling. Replace the wiper or pad with a spare if needed. If the probe does not show an increase in output or the wiper does not park correctly, then stop the calibration and determine the cause of the problem.
2. Turn on the meter and select "Calibrate" from the main menu. Select "Turbidity" from the calibrate screen.
3. Place the turbidity calibration reagent into a clean, dry, and pre-rinsed transport/calibration cup.

   WARNING: Calibration reagents may be hazardous to your health.
4. Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of the calibration reagent that can be discarded.
5. Carefully immerse the sensor end of the probe module into the calibration reagent.
6. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell. The sensor must be completely immersed past its vent hole.
7. Screw the transport/calibration cup on the threaded end of the probe module and tighten securely. Do not over-tighten inasmuch as this could cause damage to the threaded portions.
8. Use the keypad to enter the calibration value of the calibration reagent being used. Press "Enter." The turbidity calibration screen will be displayed. Allow at least 1 minute for equilibration before proceeding. The current readings of all enabled sensors will appear on the screen and change with time as they stabilize.

9. Observe the reading under turbidity. When the reading shows no significant change for approximately 30 seconds, press "Enter." The screen will indicate that the calibration has been accepted and display a prompt to press "Enter" again to continue.
10. Press "Enter." This will bring up the turbidity calibration selection screen. Press "Escape" to return to the calibration menu.
11. Rinse the probe module and sensors in tap or purified water and dry.

E. pH Calibration

To calibrate for pH:

1. Turn on the meter and select "Calibrate" from the main menu. Select "pH" from the calibrate screen. The following options will be available:
    - **1-point:** Select the 1-point option only if adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, the calibration can be adjusted by carrying out a 1-point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will display a prompt to select only one pH buffer.
    - **2-point:** Select the 2-point option to calibrate the pH sensor for two calibration reagents. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a 2-point calibration with pH 7 and pH 4 buffers is sufficient. A 3-point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement because the pH is not within this higher range.
    - **3-point:** Select the 3-point option to calibrate the pH sensor using three calibration reagents. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method ensures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as that for a 2-point calibration, but the software will display a prompt to select a third pH buffer.
2. The 2-point option is recommended. Select the 2-point option.
3. Place the correct amount (see Table 1) of pH calibration reagent into a clean, dry, and pre-rinsed transport/calibration cup. For maximum accuracy, the selected pH buffers should be within the same pH range as that of the water being sampled.

    WARNING: Calibration reagents may be hazardous to your health.
4. Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of calibration agent that can be discarded. Be certain that you avoid the cross-contamination of buffers with other solutions.
5. Carefully immerse the sensor end of the probe module into the solution.

6. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor. The sensor must be completely immersed. Using the recommended volumes from Table 1, ensure that the sensor is covered.
7. Screw the transport/calibration cup on the threaded end of the probe module and tighten securely. Do not over-tighten inasmuch as this could cause damage to the threaded portions.
8. Use the keypad to enter the calibration value of the buffer being used at the current temperature. pH vs. temperature values are printed on the labels of all YSI pH buffers.
9. Press "Enter." The pH calibration screen will be displayed. Allow at least 1 minute for temperature equilibration before proceeding. The current readings of all enabled sensors will appear on the screen and change with time as they stabilize.
10. Observe the reading under pH. When the reading shows no significant change for approximately 30 seconds, press "Enter." The screen will indicate that the calibration has been accepted and display a prompt to press "Enter" again to continue.
11. Press "Enter." This will bring up the specified pH calibration screen.
12. Rinse the probe module, transport/calibration cup, and sensors in tap or purified water and dry.
13. Repeat Steps 3 through 10 above using a second pH buffer.
14. Press "Enter." This will bring up the pH calibration screen. Press "Escape" to return to the calibrate menu.
15. Rinse the probe module and sensors in tap or purified water and dry.

F. Precautions

1. Exercise caution when using calibration reagents. Reagents that are used to calibrate this instrument may be hazardous to your health.
2. Wear gloves when using calibration reagents.
3. Avoid inhalation, skin contact, eye contact, and ingestion of calibration reagents.
4. Do not attempt to disassemble or tamper with any electrical component or batteries within the rechargeable battery pack. Never dispose of the battery pack in fire.
5. Do not charge the battery pack outside the 0 to 40°C temperature range.
6. Do not use or store the battery at high temperature, such as in strong direct sunlight, in cars during hot weather, or directly in front of heaters.
7. Do not expose the battery pack to water or allow the terminals to become damp.
8. Avoid striking or dropping the battery pack. If the pack appears to have sustained damage or malfunctions after an impact or drop, do not attempt to repair the unit. Instead, contact YSI customer service.

9. Refer to the YSI operations manual (YSI 2011) for additional customer service information.

G. Data download

Data collected using moored systems will be downloaded at regular intervals (i.e., during servicing approximately every 20 days) and transferred to Windward's information manager for final upload/storage.

Data files recorded by the instrument may be tracked by date/time stamp and associated navigational data. Furthermore, sensor data files should be logged to track location, start and end times, and the associated file sequence.

Note: each vessel-based monitoring event or mooring should have a new configuration file name to aid data file tracking. The field laptop time/clock should be checked against an accurate source (e.g., cell phone or DGPS time stamp) at the start of the monitoring event to ensure accurate time synchronization for these tidally sensitive data.

VI. Quality Control

All of the sensors, except that for temperature, require periodic calibration to ensure high performance. To ensure accuracy, the YSI should be calibrated during every servicing/data retrieval visit.

VII. Documentation

Field personnel are responsible for documenting field activities related to the DO monitoring program. Observations and data will be recorded with ink in a field logbook with consecutively numbered pages. The information in the field logbook will include, at a minimum:

- Name(s) of field personnel
- Date and times of activities
- Field deviations and communications
- Daily health and safety briefings
- Instrument calibration results

VIII. References

Windward. 2009. Lower Passaic River Restoration Project. Lower Passaic River Study Area RI/FS. Quality Assurance Project Plan: Surface sediment chemical analyses and benthic invertebrate toxicity and bioaccumulation testing. Final. Prepared for Cooperating Parties Group, Newark, New Jersey. Windward Environmental LLC, Seattle, WA.

YSI. 2011. 6-series multiparameter water quality sondes: user manual. Revision H. YSI Incorporated, Yellow Springs, OH.

Attachment B: Protocol Modification Form

Project Name and Number: _____

Material to be Sampled: _____

Measurement Parameter: _____

Standard Procedure for Field Collection & Laboratory Analysis (cite reference):

Reason for Change in Field Procedure or Analysis Variation: _____

Variation from Field or Analytical Procedure: _____

Special Equipment, Materials or Personnel Required: _____

Initiator's Name: _____ Date: _____

Project Manager: _____ Date: _____

QA Manager: _____ Date: _____

USEPA Authority: _____ Date: _____

Oversize Figure